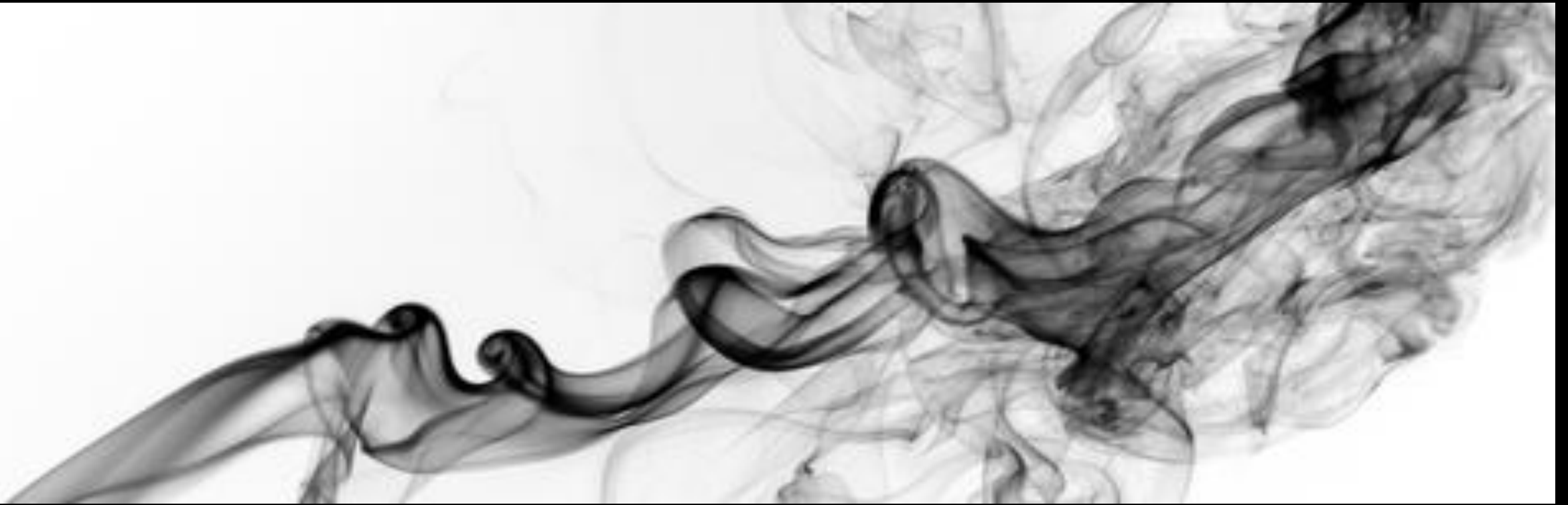


Vapor Intrusion Mitigation

Engineering controls for indoor air protection of large commercial structures



Lindsay Swearingen – Specialty Earth Sciences & Vapor Emergency



Agenda:

- Sub-slab communication testing
- Layout and Design – active SSD systems
- Project Summary

Sub-slab communication testing – preliminary steps

Identify possible sources of short circuiting such as:

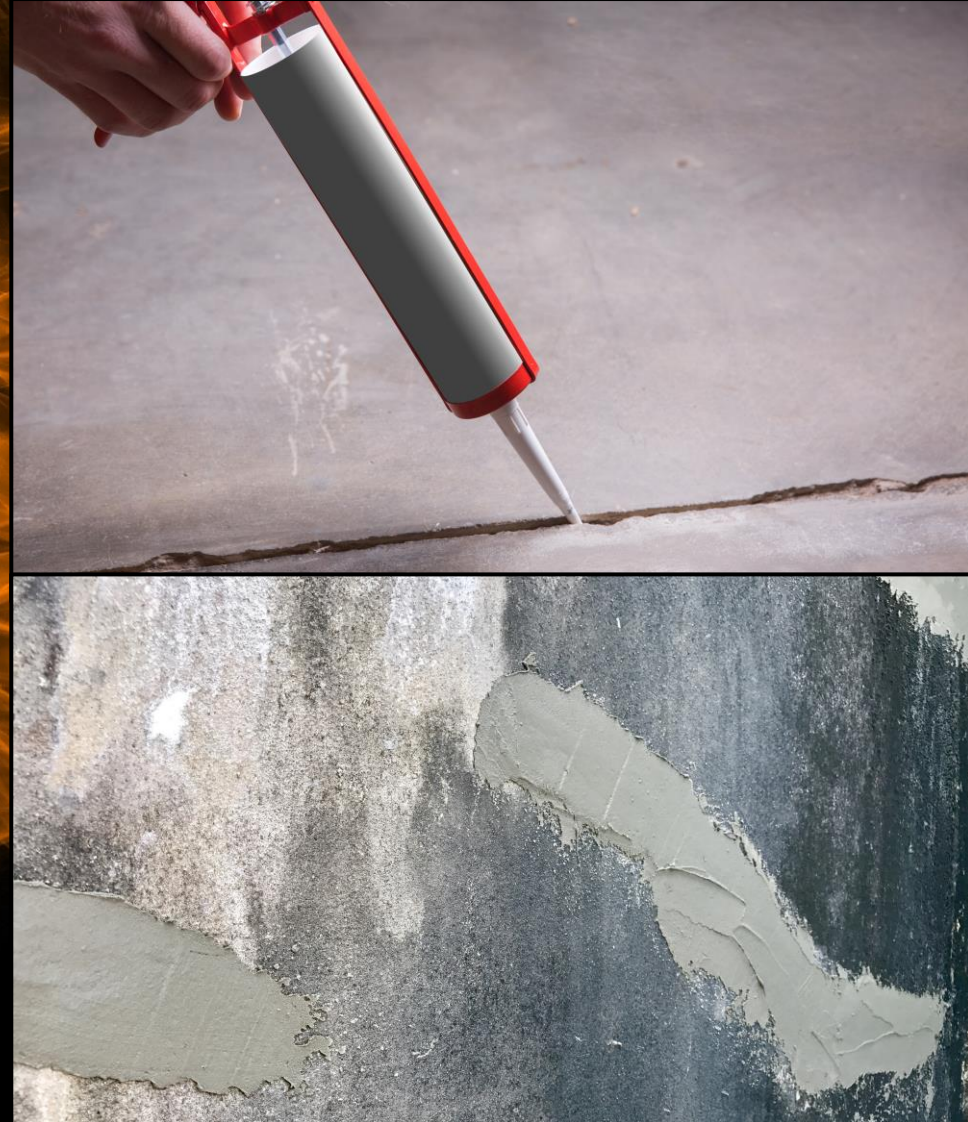
- Cracks in concrete slab
- Poorly sealed concrete around utility conduit and plumbing



Sub-slab communication testing – preliminary steps

Sealing concrete and sources of short circuiting:

- Cement grout may be necessary in large cracks and fissures
- Low VOC polyurethane caulk in smaller slab cracks and around entry point of pipes and utilities



Sub-slab communication testing

Vacuum extraction testing

Determining the potential ROI



Installation of
extraction port

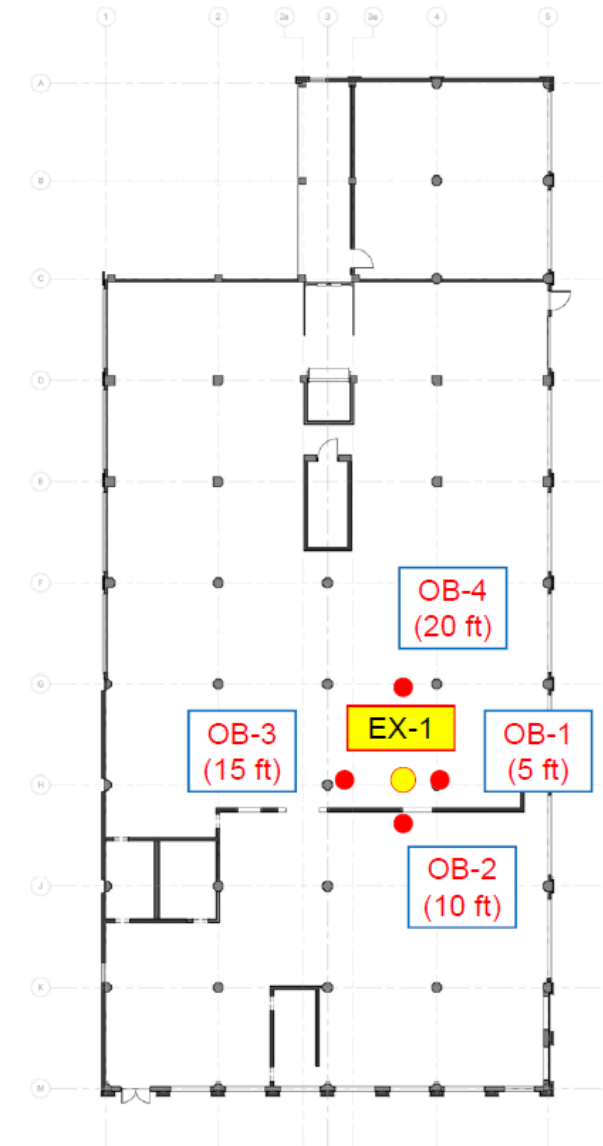
Installation of off-set
observation ports
(ex. 5, 10, 15, 20 ft)



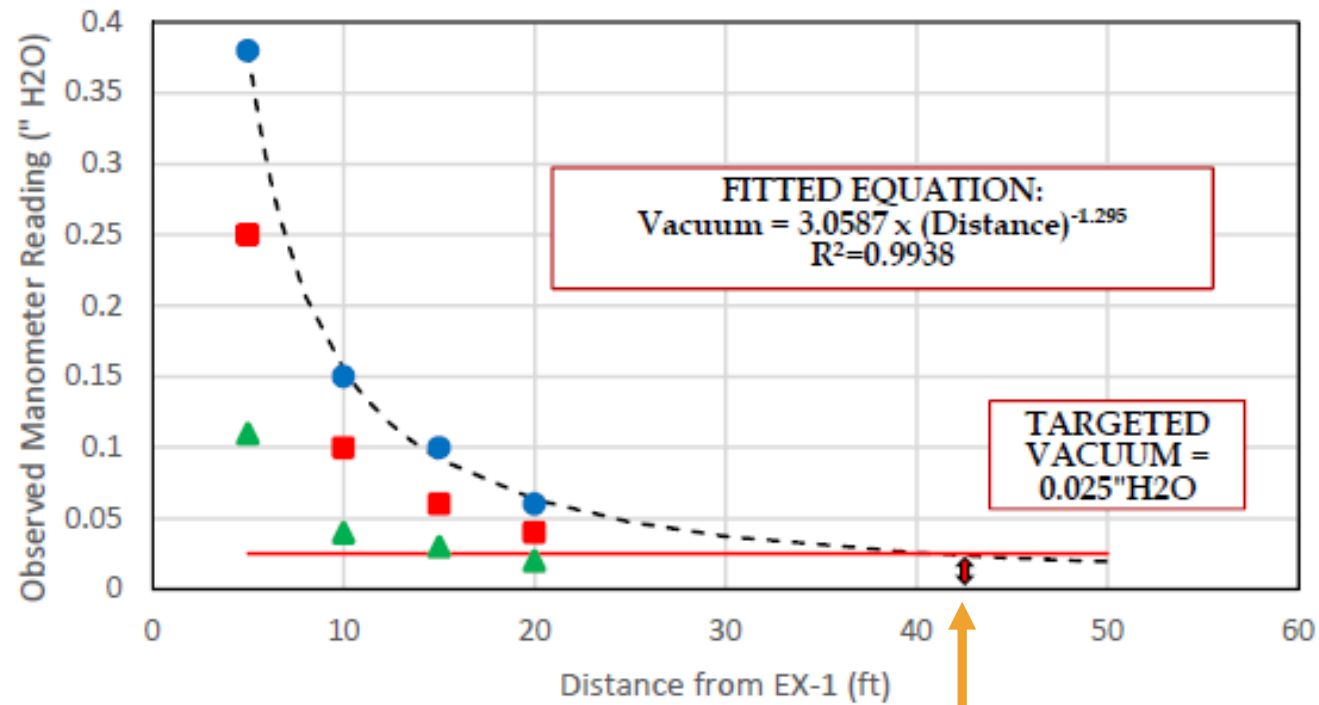
Data and interpretation

TEST RESULTS IN SUB-SLAB

Well ID:	EX-1	OB-1	OB-2	OB-3	OB-4
Purpose:	Extraction	Observation			
Offset Distance (ft):	0	5	10	15	20
Applied Vacuum (inH ₂ O)	Observed Vacuum Response (inH ₂ O)				
3.4	0.11	0.04	0.03	0.02	
6	0.25	0.1	0.06	0.04	
7	0.38	0.15	0.1	0.06	

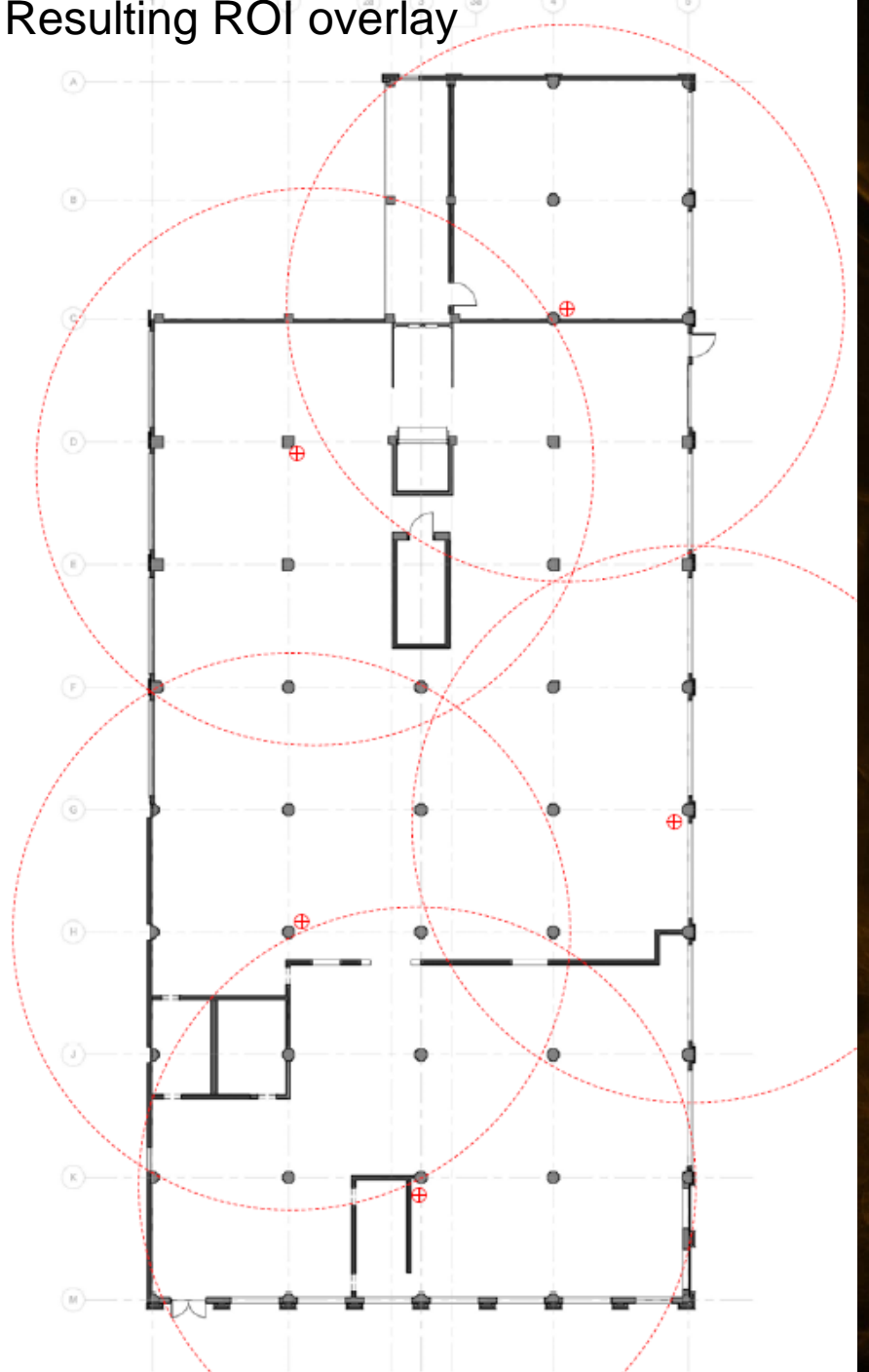


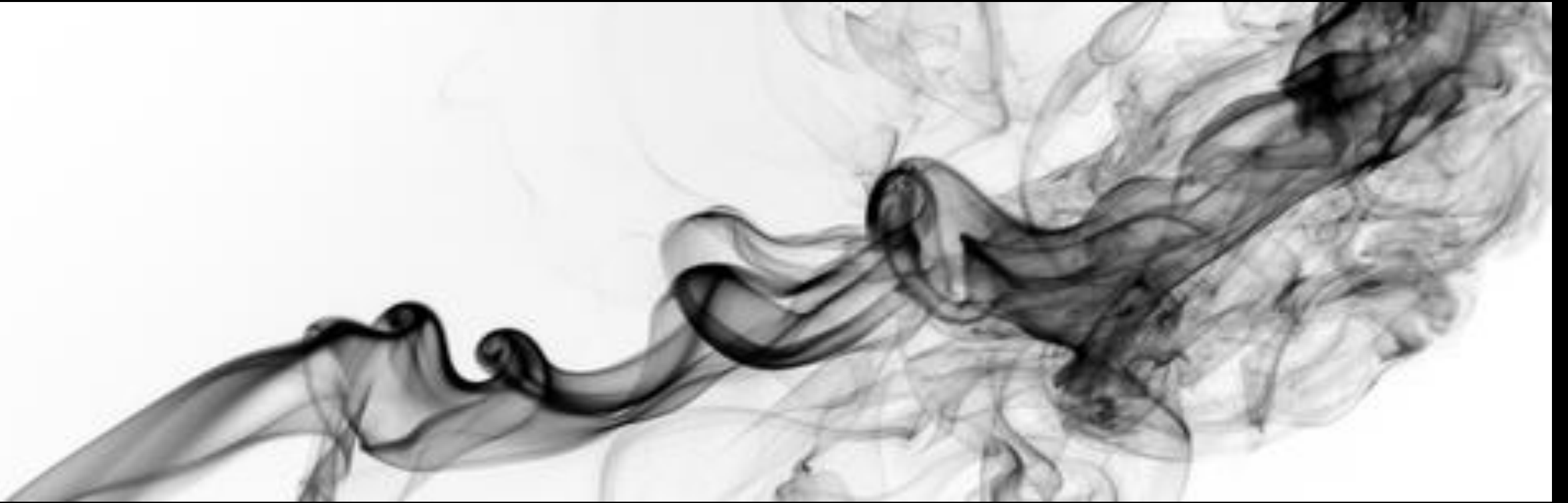
ROI determination



ESTIMATED RADIUS OF
INFLUENCE (At 0.025" H₂O)

Resulting ROI overlay

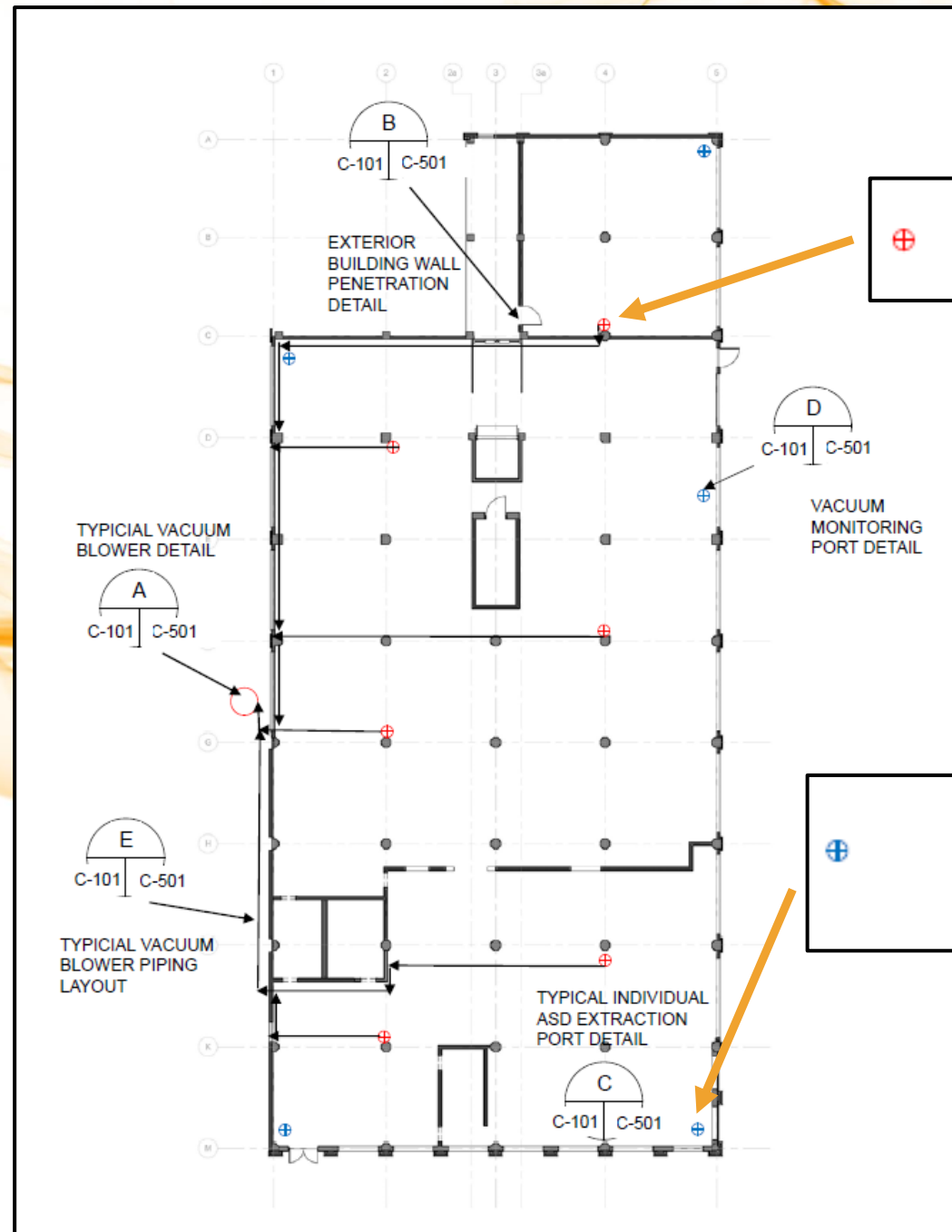




SSDS Layout and Design

Existing Structures- SSDS Layout and Design

- ROI as determined by sub-slab communication testing
- Structural and aesthetic considerations



4" EXTRACTION PORT

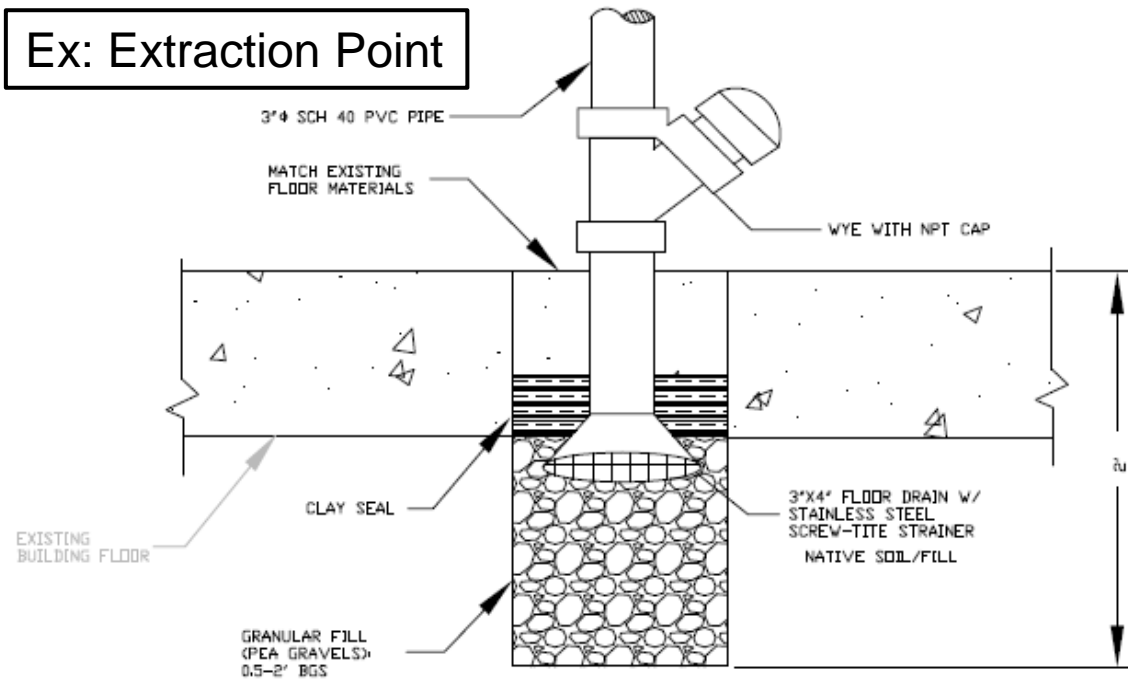
Total of 6 extraction
points recommended



PROPOSED VACUUM
MONITORING LOCATIONS

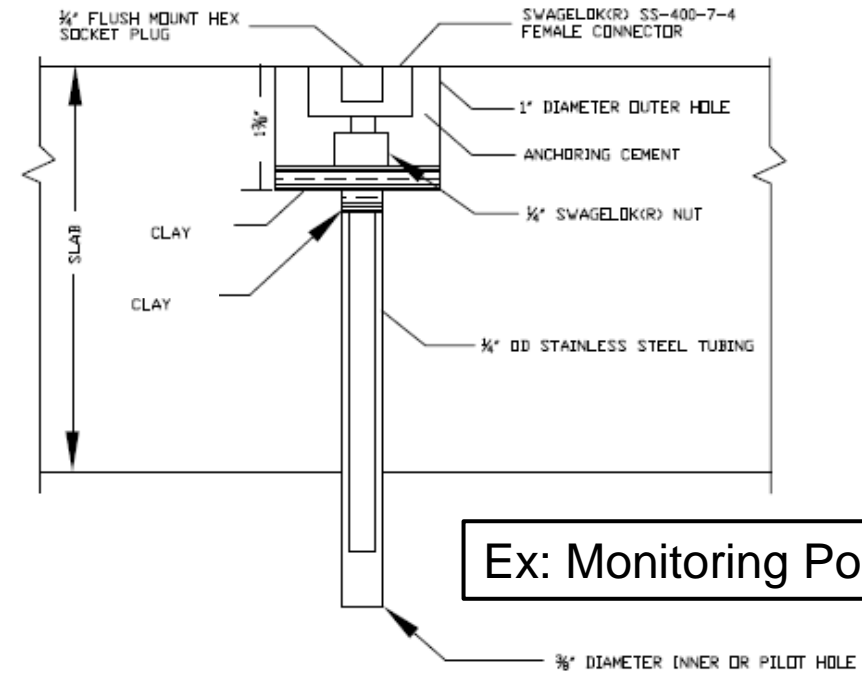
Total of 5 vacuum
monitoring points
recommended

Ex: Extraction Point



TYPICAL INDIVIDUAL EXTRACTION PORT DETAIL

NTS



Ex: Monitoring Point

TYPICAL VACUUM MONITORING PORT DETAIL

NTS



Existing Structures - SSDS Layout and Design

Sub-Slab Vapor Collection Lines

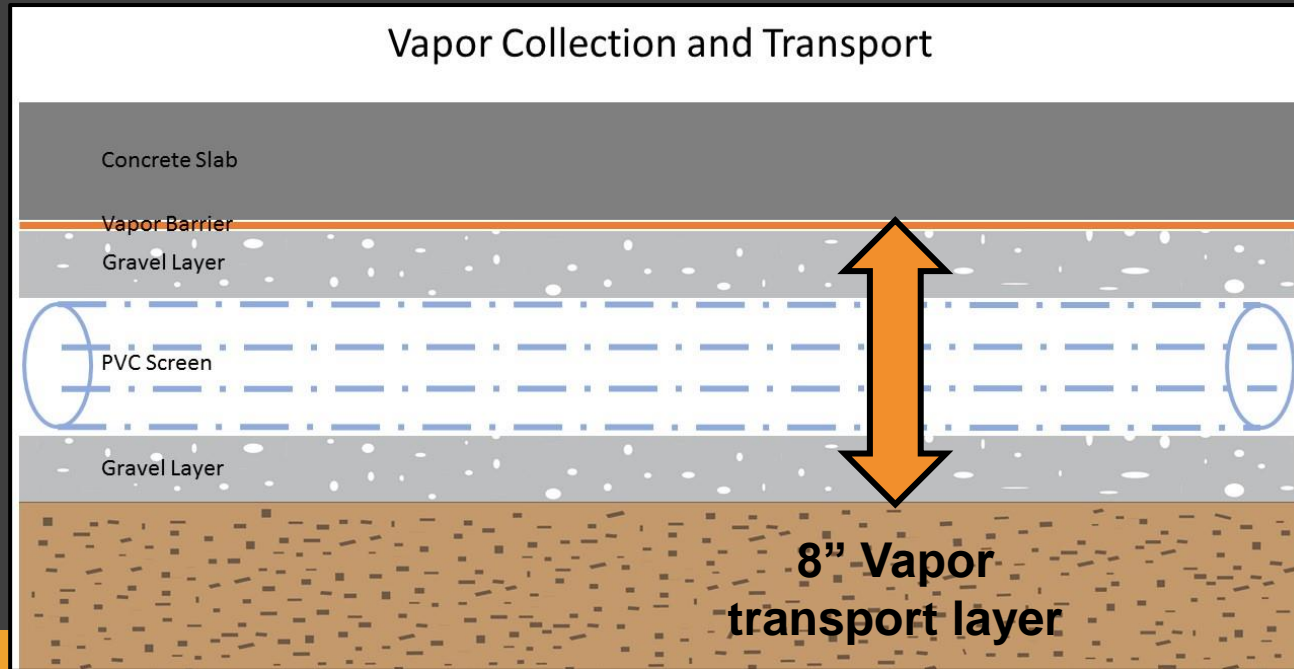


- Typically 4 inch screened PVC (ex. PVC Sch 40, 0.010 screen)
- Custom screen slotting may be required with long collection line runs

New Construction -
SSDS Layout and Design

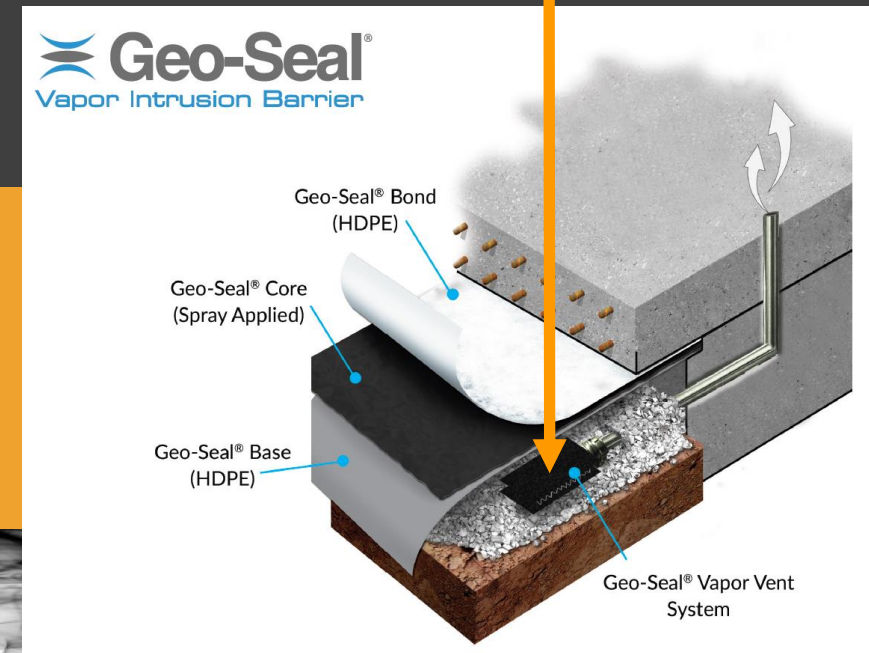


Sub-Slab Vapor Collection Lines



Installed with a minimum of 2 inches of gravel above and below collection lines to facilitate vapor transport

ALTERNATIVE - Low profile, 1 inch rectangular collection pipe is also available



New Construction -
SSDS Layout and Design

**** Reduces vapor transport layer to 5"**

Vapor Barrier - Options



VAPOR RETARDER

SHEETING installed beneath concrete slab pour



Seal seams of barrier sheets



Seam Tape



Mastic

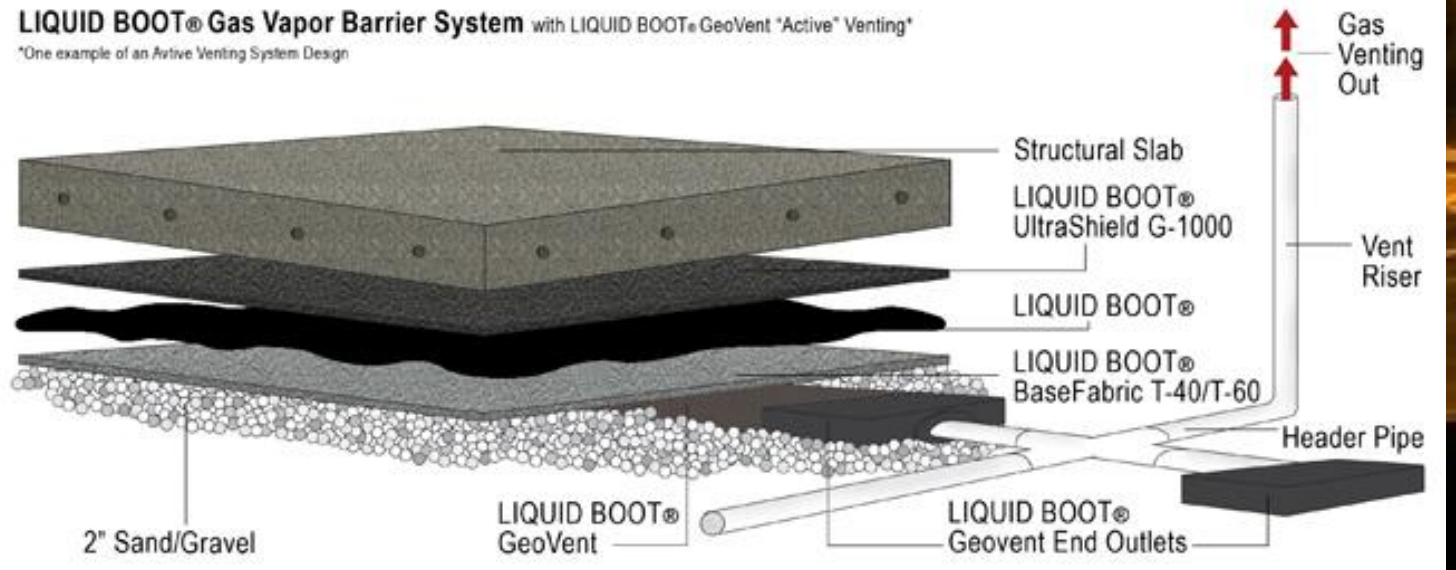
Applied at breach points (ex. pipes, utilities, support beams)

Vapor Barrier - Options



SPRAY-ON vapor barrier applied
beneath concrete slab pour

LIQUID BOOT® SPRAY-APPLIED GAS VAPOR BARRIER



Blower Selection: Types and General Features

Inline
Rotary Fan



Radon fan

- Low vacuum
- Low air flow

Centrifugal
Blower



Cincinnati fan

- Moderate vacuum
- Moderate air flow

Regenerative
Blower



Rotron blower

- Low vacuum
- High air flow

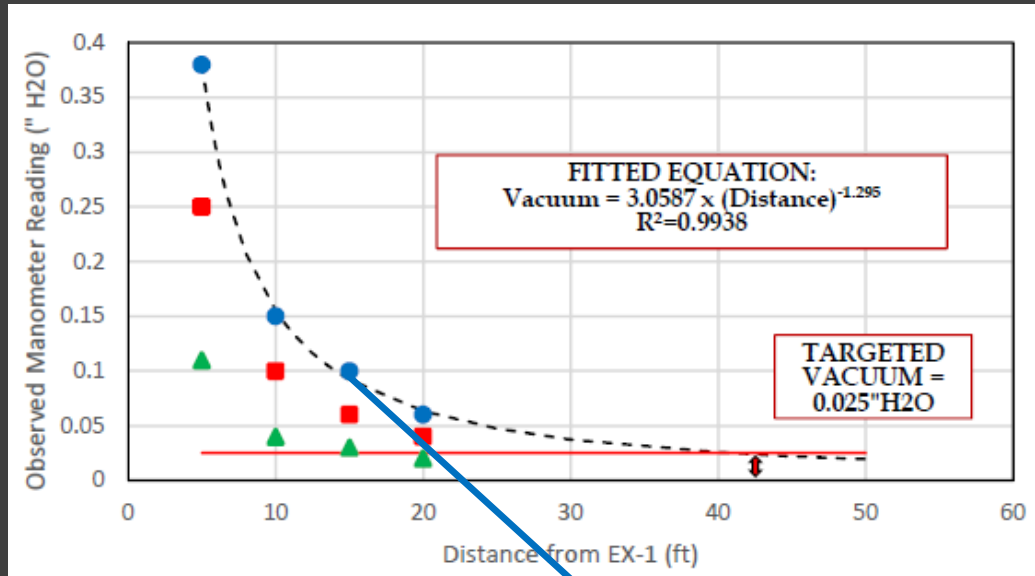
Positive Displacement
Blower



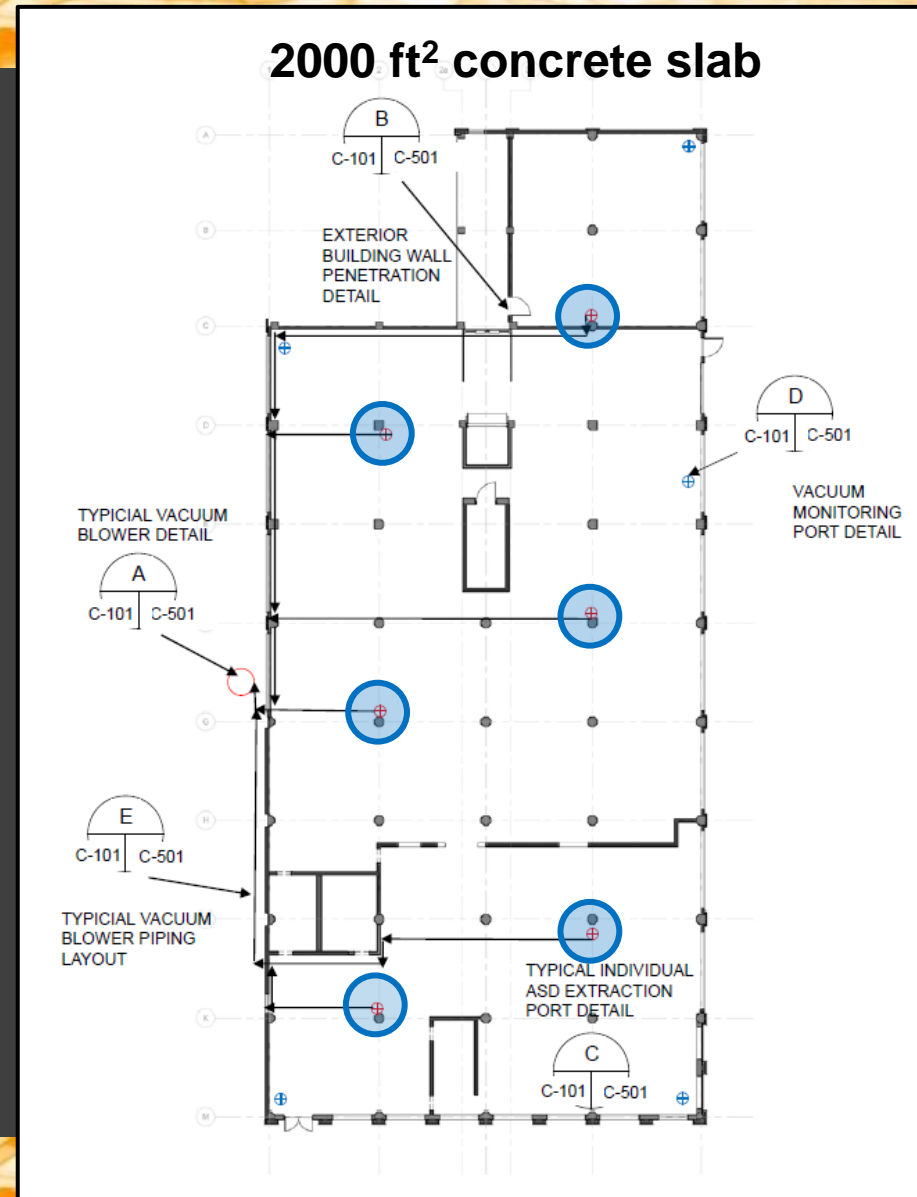
Roots blower

- High vacuum
- High air flow

Blower Selection: Site requirements and energy efficiency



EX-1					
Applied Vacuum (inches H2O)	Air Velocity (fpm)	Diameter Pipe (in)	Air Flow Rate (acfm)	Temperature (°F)	Air Flow Rate (scfm)
3.4	1238	2	27.0	55	27.5
6	2346	2	51.2	55	51.7
7	3568	2	77.8	55	78.4



Blower requirements:

- 1) Approx 80 scfm x 6 extraction points = 480 scfm total
- 2) Adding a 20% safety and expansion factor
 → **575 scfm**
- 3) Capable of efficient, constant operation at
 → **7+ inches H2O vacuum**

Blower Selection

Requirements

- 575+ scfm = moderate air flow
- 7"+ static pressure = moderate pressure

Centrifugal Blower

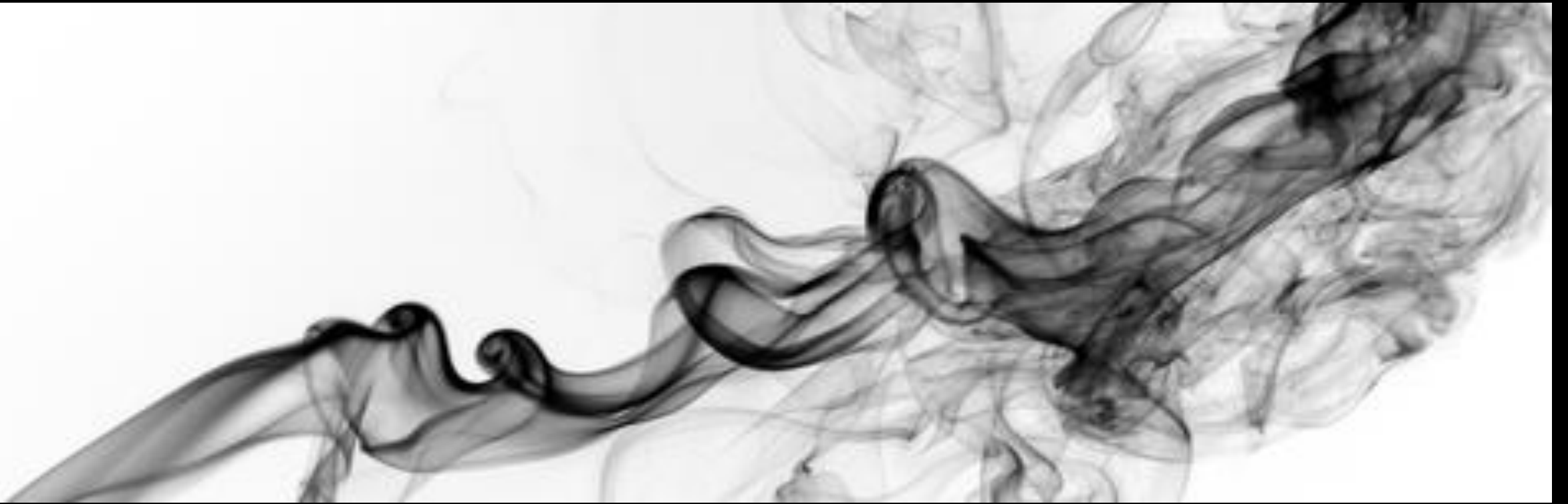


PB SERIES DIRECT DRIVE RATING TABLES at 3450 RPM

CFM and BHP at Static Pressure Shown

Ratings at 70°F., .075 Density, Sea Level

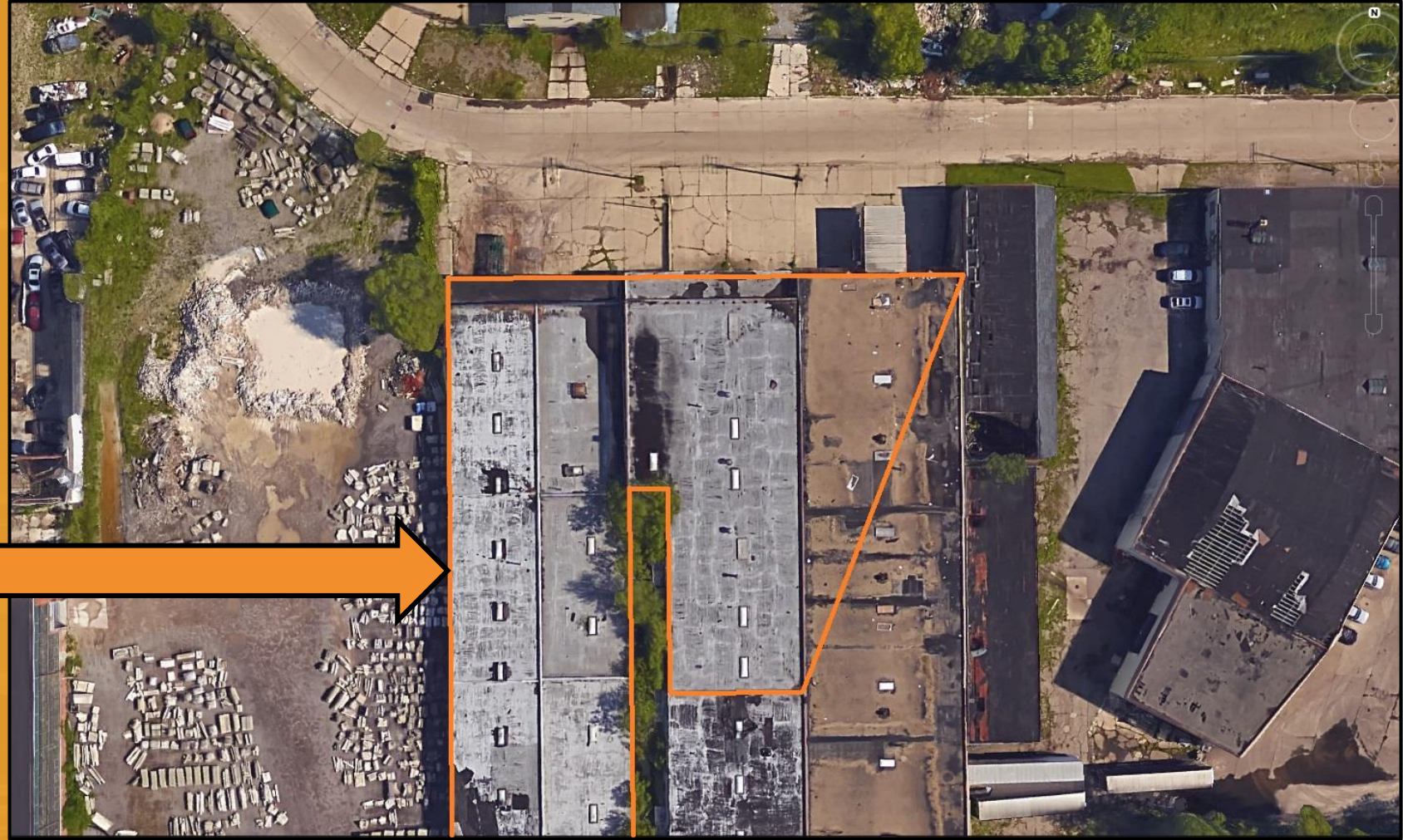
MODEL NO.	NOMINAL WHEEL DIA. & WIDTH	NOMINAL INLET DIA.	1" SP		2" SP		3" SP		4" SP		5" SP		6" SP		7" SP		8" SP	
			CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP
PB-8	7 x 2 ⁷ / ₁₆	4"	280	.30	228	.28	138	.26										
	8 x 2 ³ / ₄	4"	344	.36	292	.33	228	.28	122	.23								
PB-9	8 x 2 ³ / ₄	5"	388	.39	341	.36	285	.32	156	.25								
	8 ¹ / ₂ x 2 ³ / ₄	5"	435	.46	385	.41	324	.37	243	.33								
	9 x 2 ⁷ / ₈	5"	493	.52	445	.48	384	.42	310	.37	196	.31						
	10 ¹ / ₄ x 3 BC	5"	511	.56	463	.50	404	.45	344	.42	283	.38	211	.33				
	9 ³ / ₄ x 2 ⁷ / ₈	5"	549	.81	501	.76	449	.71	395	.66	335	.60	258	.51				
PB-10A	10 ⁵ / ₈ x 2 ⁵ / ₈	5"	592	.84	552	.78	509	.72	463	.66	415	.59	360	.52	291	.44	141	.31
	9 x 2 ⁷ / ₈	6"	576	.70	510	.65	425	.58	325	.50	163	.37						
	10 ¹ / ₄ x 3 BC	6"	605	.79	547	.72	479	.66	399	.60	299	.53	149	.43				
	9 ³ / ₄ x 2 ⁷ / ₈	6"	710	1.02	658	.96	594	.89	517	.82	428	.72	314	.59	109	.42		
	11 x 3 BC	6"	729	1.06	687	1.01	638	.95	580	.88	511	.81	425	.71	306	.59		
	10 ⁵ / ₈ x 2 ⁵ / ₈	6"	826	1.39	763	1.30	699	1.23	632	1.15	559	1.06	476	.96	361	.83		
	11 x 2 ³ / ₄	6"	830	1.42	780	1.33	727	1.23	670	1.15	607	1.06	537	.97	450	.87	307	.70
	11 ¹ / ₂ x 2 ⁷ / ₈	6"	884	1.52	836	1.45	780	1.38	718	1.30	652	1.22	582	1.14	506	1.04	414	.92
PB-12A	12 x 2 ⁷ / ₈	6"	921	1.93	886	1.89	846	1.84	801	1.78	750	1.70	691	1.61	622	1.51	540	1.39
	11 x 3 BC	7"	877	1.10	807	1.04	729	.96	642	.88	543	.79	419	.69	181	.51		
	10 ⁵ / ₈ x 2 ⁵ / ₈	7"	1062	1.62	989	1.53	899	1.42	795	1.29	681	1.15	553	.99	378	.78		
	11 x 2 ³ / ₄	7"	1155	2.00	1068	1.85	974	1.71	873	1.56	762	1.40	636	1.23	487	1.04	281	.78
	11 ¹ / ₂ x 2 ⁷ / ₈	7"	1266	2.39	1183	2.28	1092	2.14	997	2.00	900	1.85	798	1.69	686	1.51	547	1.30
	12 x 2 ⁷ / ₈	7"	1307	2.61	1225	2.46	1139	2.30	1052	2.15	965	2.00	876	1.86	784	1.72	681	1.56
	13 x 3 ¹ / ₄ BC	7"	1297	2.61	1233	2.51	1164	2.40	1093	2.29	1021	2.17	947	2.06	871	1.96	791	1.84
	12 ¹ / ₄ x 2 ⁷ / ₈	7"	1363	2.92	1287	2.76	1202	2.58	1114	2.40	1025	2.22	936	2.06	845	1.90	748	1.74
	13 x 3 ¹ / ₄	7"	1464	3.24	1388	3.08	1306	2.92	1222	2.77	1139	2.61	1058	2.47	978	2.32	897	2.17



Site Summary

Site Summary – overview

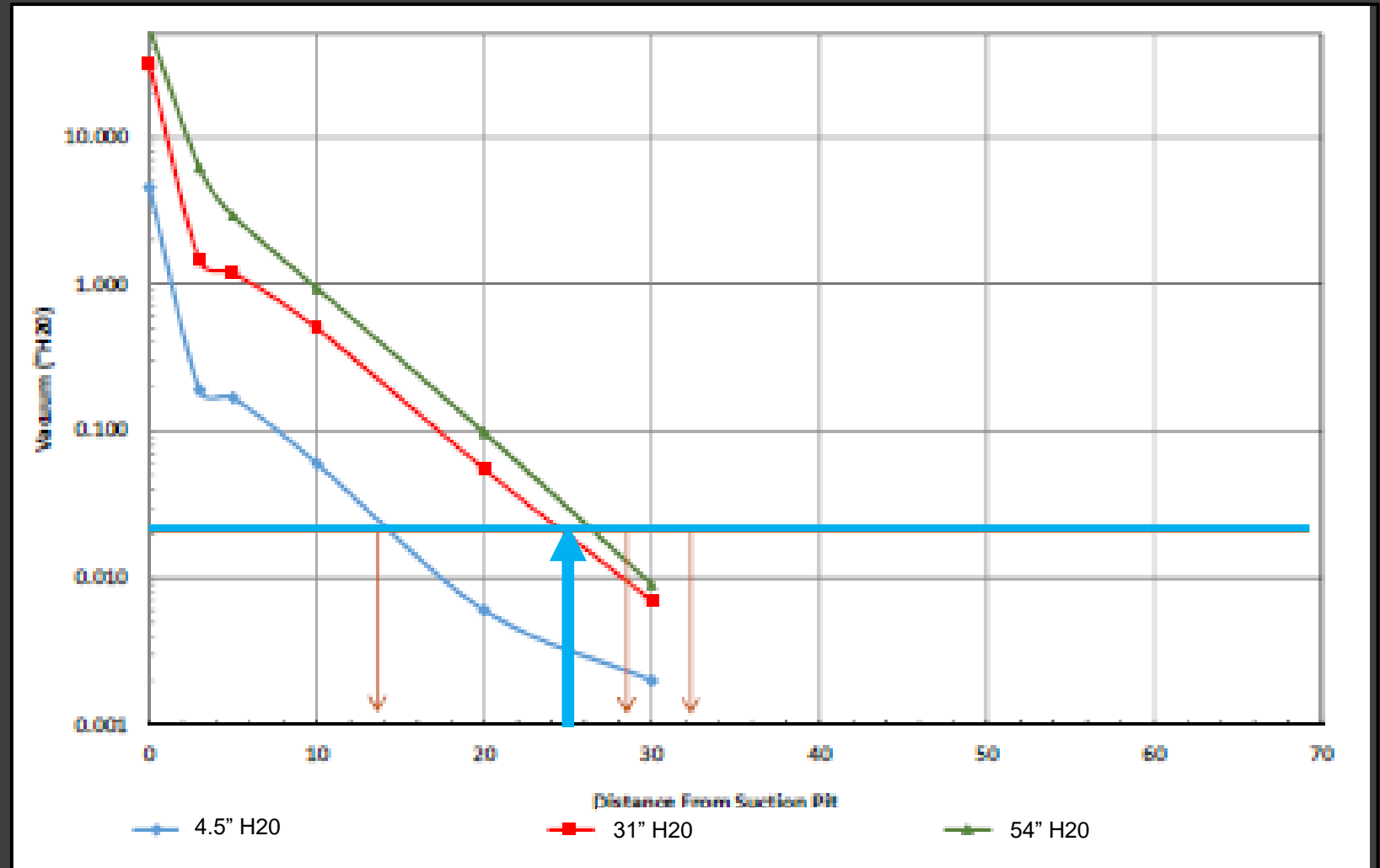
- Former manufacturing facility
- Currently used as warehouse
- CVOC impacts to soil & GW
- 45,000 ft² target area for sub-slab depressurization



Site Summary – communication testing

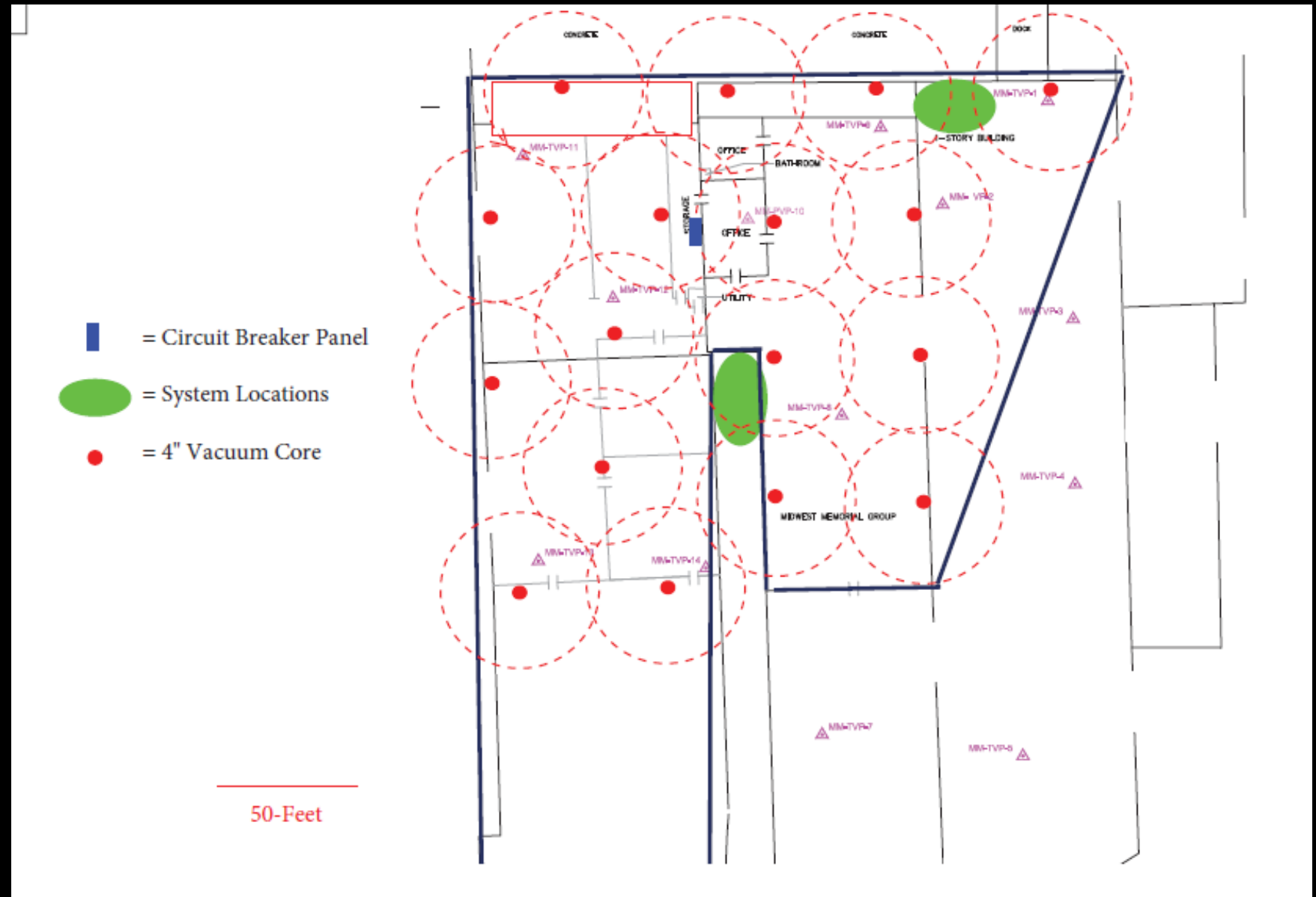
ROI:

- Agency requires sub-slab negative pressure $\geq 0.02''$ H₂O
- ROI of 25 ft used to design installation layout



Site Summary – Layout

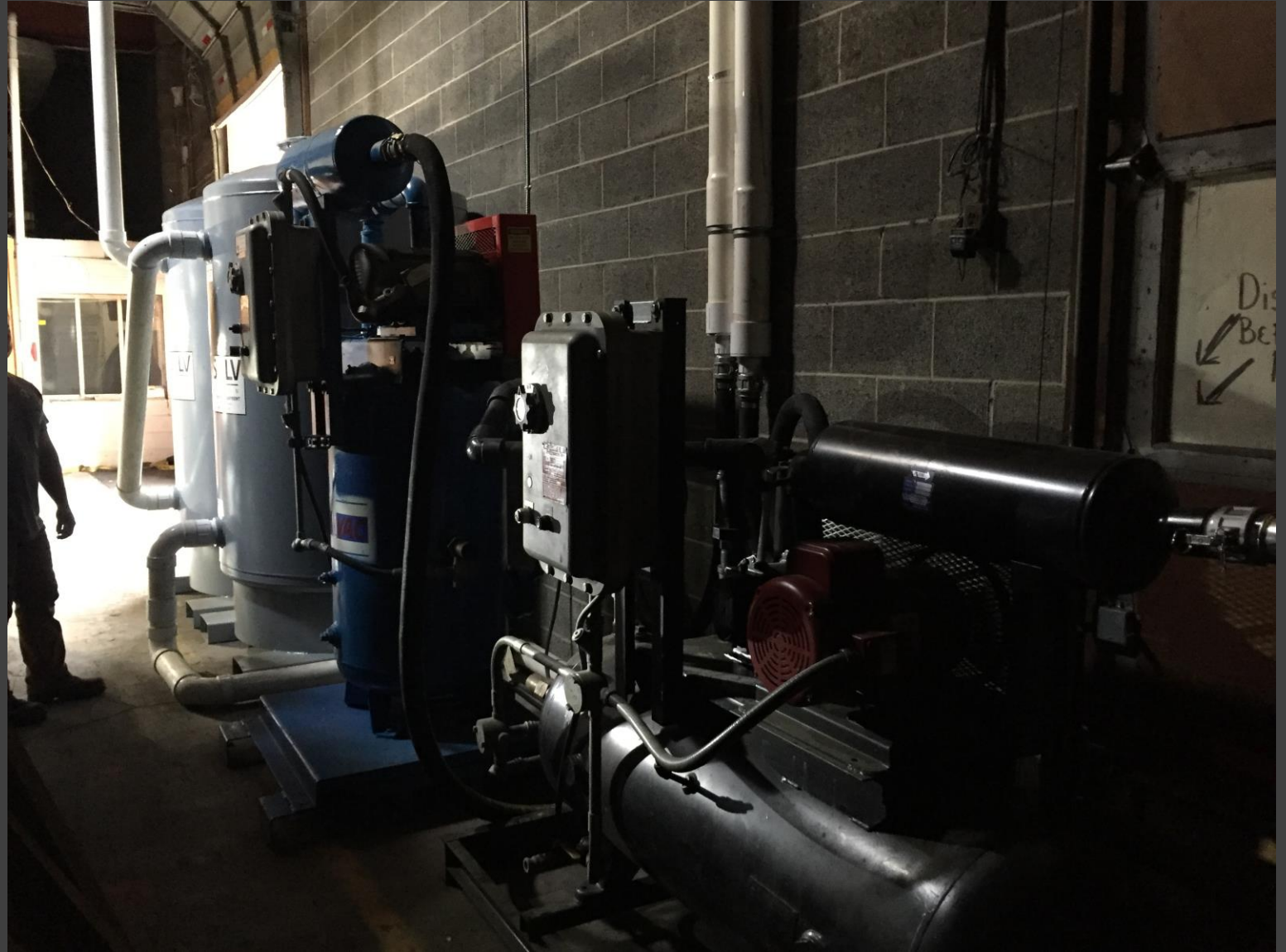
**17 extraction
points at 25 ft ROI**
required to
sufficiently cover the
target
depressurization
area



Site Summary – SSD System

PD BLOWERS

- 1) Roots URAI 36 Blower Skid
- 2) Roots URAI 24 Blower Skid
- 3) Vapor carbon treatment required prior to discharge



Site Summary – System Installation Logistics



Extraction point →
conveyance line



Conveyance line → blower



Vapor carbon treatment →
discharge line

VaporEmergency.com

(833) NO VAPOR



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